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Effect of the large scale environment on the internal dynamics of early-type galaxies

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Abstract. We have studied the population-density relation in very sparse environments, from poor clusters to isolated galaxies, and we find that early-type galaxies with a young stellar population are preferably found in the lowest density environments. We show a marginal indication that this effect is due to an enhancement of the stellar formation independent of the morphological segregation, but we failed to find any effect from the internal dynamics.

1. Background

It is generally accepted that the rate of star formation in early-type galaxies is enhanced in low-density environments (Schweizer & Seitzer 1992, de Carvalho & Djorgovski 1992, Guzmán et al. 1992, Rose et al. 1994, Jørgensen & Jønch-Sørensen 1998, Bernardi et al. 1998). It results in a population - density relation: The metallic features in the spectra (eg. Mg2) are weaker and the Balmer lines stronger in low-density regions.

Recently (Prugniel et al. 1999) we have analyzed the population-density relation in low-density environments (isolated galaxies to poor clusters). We found that the early-type galaxies which are likely to contain a young sub-population are mostly found in the sparsest environments.

The approach used to diagnostic this effect is to study the Mg_2–σ_0 and the Fundamental Plane (FP) relations. Indeed, although both relations are sensitive to the dynamics and to the stellar content, departures resulting from one or the other origin will have opposite signs. One the one hand, if a galaxy is found below the Mg_2–σ_0 relation (see Fig. 1), it may have either an unusually low velocity dispersion or a high Mg_2 index. On the other hand, a galaxy below the FP relation has either a low velocity dispersion or contains a young population.

Our analysis of the residuals shows that the environment has primarily a visible effect on the stellar content (not on the dynamics).

2. Dynamical evolution

It is not a surprise that an enhancement of the young population is detected: A relatively small fraction of young stars is sufficient to significantly modify the broad-band colors and the line strength indices.

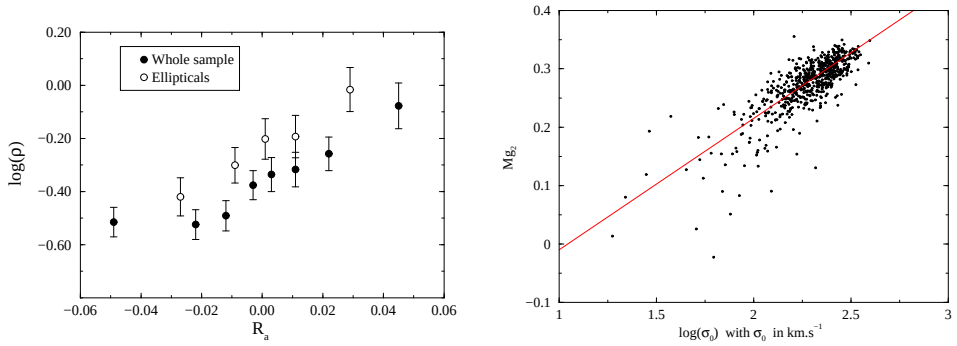

Figure 1. Left : Mean density of the environment ($\log \rho$) vs residuals of the Mg_2-σ_0 relation for the whole sample (filled symbols, 80 objects in a point) and *bona-fied* ellipticals only (open symbols, 40 objects in a point) The error bars are 1σ uncertainties. Right: The Mg_2–σ_0 diagram of our sample with the classical relation Mg2=0.225**log*(σ_0)-0.235.

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However, the enhancement of the stellar formation should have a long term effect on the dynamics of the galaxies. This delayed star formation in early-type galaxies is mostly occurring in the central regions and hence modifies the mass balance in these galaxies.

Unfortunately, when we into account the stellar population effect as deduced from the residuals to the Mg2-σ relation, no more environmental effect persist in the FP analysis. We cannot find any dynamical evolution with this analysis. However, the FP analysis mostly diagnoses the equilibrium status of the galaxies, and this long term evolution is not expected to significantly disturb the equilibrium. However, the FP analysis is also sensitive to the details of the dynamics and of the structure (see Prugniel et al. 1997).

Using data collected in the Hypercat database, in particular the kinematic and photometric profiles, we are trying to study the systematics of these non-homologies and their relation with the environment.

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